

OBSERVATIONS

a) - Concerning the objections formulated by the Examiner on the concept of clearness of the term "épanouissement", the Depositor maintains
5 this term. The term "épanouissement" is described clearly in initial description and does not comprise any ambiguity. The term "épanouissement" is defined on page 5 and lines 20-24 by these terms: "On constate, que le rayonnement parallèle 18 schématiquement représenté sous la forme **d'un fin faisceau** issu du cœur de faible diamètre 6 de la fibre optique 5 **s'épanouit**
10 maintenant sous la forme **d'un faisceau plus large** bien adapté à pénétrer dans la fibre optique 9 de diamètre 10 de cœur plus large". Consequently the term "s'épanouit" has well the meaning of the transformation of a beam which passes from slim to wide. The term is then clear and without ambiguity.

- Concerning the objections formulated by the Examiner on the
15 concept of clearness on the term "épanouissement des rayons lumineux", the Depositor enclosed a new claim 1 in which the blooming is that of the blooming of the beam of the luminous rays.

b) - Concerning the objections formulated by the Examiner on the expression "(jeu de lentilles) pour permettre une adaptation de la
20 transmission des rayons lumineux dans l'espace et en densité d'énergie" the Depositor modifies this expression in "(jeu de lentilles) pour permettre une adaptation de la transmission des rayons lumineux dans l'espace et en densité d'énergie". As described on page 5 with lines 20-24, the luminous beam opens out of slim to wide, it then exists a distribution of the luminous
25 rays in space. This blooming, of the luminous beam opens out of slim to wide, involves also obligatorily a variation of density of energy. And the fact that, the luminous beam opens out of slim to wide automatically involves a difference in distribution of the luminous rays in entry and exit. Therefore, the term "différent" does not need to be introduced.

30 c) - Concerning the objections formulated by the Examiner on the designation of connector for optical ferule, the Depositor modifies this characteristic in "connecteur comportant des ports pour recevoir des férules optiques".

Concerning the defects of innovation and inventive step, the Depositor subjects the arguments according to.

The new claimed invention relates to a connector for optical ferrules which enables to simplify the Industrial interconnection of optical fiber between them or the interconnection of optical fiber with optoelectronic receivers or transmitters. There exists in the state of the art of the optical connectors. But these optical connectors comprise a complex structure. Indeed, to obtain a good performance of the interconnection between two fibers, a multitude of elements are assembled in order to maintain and to align the lenses which ensure the transmission of the optical beam of a port of entry at a port of exit. Because of their complexity, the industrial production such connectors thus proves difficult even expensive.

The purpose of the invention is to cure this problem of complexity and manufacturing cost, while increasing the performances of transmission by optical fibers. It comprises a set of two lenses, each one with a **face flat**, interposed between the two optical ports, and plated against a transparent material plate. The lenses thus carried out allow a simplified manufacture of the connectors. This enable to reduce the industrial manufacturing cost. Moreover, the performances of transmission are increased.

The document US-A-5 357 590, D3, nearest to the invention, described a device which makes it possible to limit the losses to the transmission and which interconnects on the one hand **several optical fibers** with on the other hand **several other fibers optics** whereas in the invention one only has two optical fibers. Moreover, the fibers of the invention are monomode for one and multimode fibers for the other.

The device of D3 comprises in addition spherical lenses which are inserted in cavities of a transparent plate. The faces of these plates are machined so as to be adapted to the spherical lenses. But, the lenses of D3 do not comprise faces flats, as those of the invention.

The invention is thus new with respect to D3.

Moreover, the realization of D3 is very sensitive to a misalignment of fibers at the time of their put in place facing to lenses. This problem arises more especially as one deals, for the ports, with industrial production without much precaution, possibly with plastic support. Indeed, because of the realization of lenses in the form of ball in D3, the pupils of entry or exit of the

connector are related to the diameters of these balls. If one wants to then tolerate a great misalignment, it is advisable to increase the diameters of these balls, and ipso facto the thickness of the interposed plate. A too bulky device then is obtained. In the invention, one solves the problem of the tolerance of misalignment by choosing lenses with face flat, whose the diameter (when they are spherical) is not limited any more by the thickness of the interposed plate. In the invention one showed, corresponding figure 2 and explanations, that, compared to the known solutions (D3) corresponding to the curve of transmission 25, one obtained, curve 27, a much better tolerance. Moreover, the invention with lenses with face flat authorizes aspherical lenses whereas such aspherical lenses are unusable with D3.

Consequently, the Expert which knows D3, and which is confronted with the problem of adaptation of the transmission cannot imagine to replace the plate with cavities of D3 by a plane plate on which the lenses with face flat are plated. The invention is inventive with respect to D3.

The document JP-a-63 148210, D5, described an optical element which makes it possible to separate an incidental optical ray in several optical rays. This system is then a separator and not a simple transmitter (connector with ferules) as in the invention. D5 does not mention, as in the invention, that the luminous beam opens out of slim to wide. D5 describes a system which does not comprise a conversion of a mode monomode (multimode) towards a mode multimode (monomode). The system of D5 does not comprise lenses with face flat plated on a plate.

The invention is thus new compared to D5. Because of the destination different of D5, the Expert which looks for an adapter, will not look for a teaching in the separators. Thus it will not find D5. Moreover, when well even it would find D5, the modifications to be brought there are so numerous that an approach of the invention starting from D5 raises more approach a posteriori than of the approach a priori. Consequently the invention is inventive with respect to D5.

The combination of D3 and D5, as suggested by the Examiner, is not possible, because no purpose of improvement of the performances is suggested or sought in these two documents. Such a combination would be thus free. The field of D3, connector, is different from that of D5, separator. Their combination is thus not natural. At last, none of these documents

describes lenses with face flat plated on a plate. Thus even the combination would not lead to the invention. The concept of integral molding envisaged by D5, "molded integrally" prevents from imagining a 'surmoulage' as in the invention which results in carrying out lenses with faces flats.

5 In the same way, none the documents D7, D8 and D9 describes, as mentioned above, that their system has:

- "a set of two lenses, each one with a face flat, interposed between the two ports optical and plated against a transparent material plate",
- "a blooming of the luminous beam opens out of slim to wide or in the 10 other direction, from one optical port to another",
- the propagation of the luminous beam is done of a fiber monomode to a fiber multimode or reciprocally.

And the Expert which knows D7 at D9 is not incited to solve the problem of adaptation of transmission of the invention since none of these 15 documents seeks to solve such a problem. The new claimed invention is thus new and inventive taking into consideration D7, D8, and D9.

Following these observations, the applicant wishes that the modifications of the request which follow upon the international preliminary examination allow the delivery of the corresponding patent.

REVENDICATIONS

(nouveau jeu)

1 - Connecteur (1) comportant des ports pour recevoir des férules optiques et pour correspondre à des conversions de propagation monomode à multimode et réciproquement, comportant un port optique d'entrée (2) et un port optique de sortie (3), caractérisé en ce qu'il comporte un jeu de deux lentilles chacune avec une face plate (14, 15), interposées entre les deux ports optiques, et plaquées contre une plaque en matériau transparent pour permettre une adaptation de transmission des rayons lumineux dans l'espace et en densité d'énergie, les deux lentilles ayant des diamètres et des rayons de courbure respectifs différents pour former un épanouissement du faisceau des rayons lumineux, de fin à large ou dans l'autre sens, d'un port optique à l'autre.

2 - Connecteur selon la revendication 1, caractérisé en ce qu'un point focal (24) de chacune des lentilles est situé dans l'espace constitué par la plaque en matériau transparent.

3 - Connecteur selon l'une des revendications 1 à 2, caractérisé en ce que la plaque transparente forme un dispositif optique convergent divergent.

4 - Connecteur selon l'une des revendications 1 à 3, caractérisé en ce que les deux lentilles ont des diamètres (20, 21) et ou des rayons de courbure (22, 23) différents.

5 - Connecteur selon l'une des revendications 1 à 4, caractérisé en ce que la plaque transparente (16) a une longueur de un millimètre environ.

6 - Connecteur selon l'une des revendications 1 à 5, caractérisé en ce qu'il est muni de deux jeux amovibles de lentilles, notamment pour correspondre à deux modes de conversion d'une propagation monomode à une propagation multimode, ou réciproquement, cette propagation multimode pouvant supporter deux types de propagation.

7 - Connecteur selon l'une des revendications 1 à 6, caractérisé en ce que la plaque en matériau transparent de préférence en verre (17) est, surmoulée par les lentilles.

8 - Connecteur selon l'une des revendications 1 à 7, caractérisé en ce que la plaque de matériau transparent, de préférence en verre, est surmoulée par une matrice de lentilles.

35 9 - Connecteur selon la revendication 8, caractérisé en ce que des

lentilles surmoulées sur une face de la plaque sont des lentilles différentes les unes des autres.

10 - Connecteur selon l'une des revendications 7 à 9, caractérisé en ce que les lentilles sont en résine surmoulée sur la plaque.

CLAIMS

1. Connector (1) comprising ports to receive optical ferrules and to correspond to single-mode to multi-mode conversions and vice versa, comprising an input optical port (2) and an output optical port (3),
5 characterized in that it comprises a set of two lenses each with a flat face (14, 15), interposed between the two optical ports and placed against a plate made of transparent material to enable an adaptation of transmission of the light rays in space and in energy density, the two lenses having respective diameters and radii of curvature that are different to form a fanning out of the
10 beam of light rays, from narrow to wide or in the other direction, from one optical port to the other
2. A connector according to claim 1, characterized in that a focal point (24) of each of the lenses is located in the space constituted by the plate made of transparent material.
- 15 3. A connector according to one of the claims 1 to 2, characterized in that the transparent plate forms a divergent-convergent optical device.
4. A connector according to one of the claims 1 to 3, characterized in that the two lenses have different diameters (20, 21) and/or
20 radii of curvature (22, 23).
5. A connector according to one of the claims 1 to 4, characterized in that the transparent plate (16) has a length of about one millimeter.
- 25 6. A connector according to one of the claims 1 to 5, characterized in that it is provided with two detachable sets of lenses, especially in order to correspond to two modes of conversion from a single-mode propagation to a multimode propagation or vice versa, this multimode propagation being capable of taking two types of propagation.
- 30 7. A connector according to one of the claims 1 to 6, characterized in that the plate, made of a transparent material that is preferably glass (17), is overmolded by the lenses.
8. A connector according to one of the claims 1 to 7, characterized in that the plate made of a transparent material that is preferably glass is overmolded by an array of lenses.

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9. A connector according to claim 8, characterized in that lenses overmolded on a face of the plate are lenses different from each other.

10. A connector according to one of the claims 7 to 9, characterized in that the lenses are made of resin overmolded on the plate.